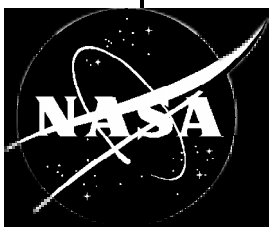
540-037

MISSION OPERATIONS AND DATA SYSTEMS DIRECTORATE

Interface Control Document (ICD) Between the Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet) and Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Ground Data System (GDS)

September 1997



National Aeronautics and Space Administration

Goddard Space Flight Center
Greenbelt, Maryland

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September 1997

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Prepared by:

Chris Garman, Project System Engineer Date
EOSDIS Backbone Network Project

Mission Systems Networks Manager:

Gene G. Knoble, Mission Systems Networks Manager Date
ESDIS Project, Code 423

Division CCB Approval:

Thomas E. Butler, Chairman Date
Nascom CCB, Code 540

Project Approval:

Arthur F. Obenschain, Project Manager Date
ESDIS Project, Code 423

Approved by:

Dr. Hiroshi Watanabe, Project Manager Date
ASTER Ground Data System
ERSDAC

Goddard Space Flight Center
Greenbelt, Maryland

Preface

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Mission Systems Networks Manager
Code 423
Goddard Space Flight Center
Greenbelt, Maryland 20771

Abstract

This Interface Control Document (ICD) describes interface agreements between the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Ground Data System (GDS) user and Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet).

Keywords: *ASTER, EBnet, Ground Data System (GDS), Interface Control Document (ICD)*

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Abbreviations and Acronyms

Section 1. Introduction

1.1 Authority

The Mission Operations and Data Systems Directorate (MO&DSD) has the authority to implement Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet). This authority was granted to the MO&DSD by the EOS project, under the Office of Mission to Planet Earth (Code Y). The EBnet project is under the National Aeronautics and Space Administration (NASA) Communications (Nascom) Division of the MO&DSD.

1.2 Purpose

The purpose of this document is to provide a detailed definition of the interface(s) between the EBnet and the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Ground Data System (GDS).

1.3 Scope

This document defines and specifies the data transport interface(s) (i.e., protocols, standards applied, physical connections, and locations connected) between EBnet and the ASTER GDS.

1.4 Time Frame

This Interface Control Document (ICD) shall be in effect from the date of the last approval signature.

1.5 Goals and Objectives

The goals of EBnet are to:

a. Implement an operational, integrated, transparent communications system that serves the data communications needs of projects supported by NASA Goddard Space Flight Center (GSFC), and users outside the MO&DSD.

b. Expand using industry standard system solutions while maintaining compatibility with the existing network and user interfaces.

c. Minimize costs for implementation, operation, and maintenance of the network.

d. Minimize life-cycle costs.

e. Maintain high availability by designing with redundancy, and without single points of failure in the Network Backbone, where required.

f. Utilize state-of-the-art technology, utilizing equipment with the best price-performance available commercially.

1.6 Standards Precedence

EBnet will be based on Government, commercial, and international standards. In case of conflict, the following precedence (in descending order) applies:

- This EBnet ICD.
- Government standards.
- Commercial and/or international standards.

1.7 Document Organization

Section 2 contains parent, applicable, and reference documents related to this ICD.

Section 3 details a systems overview of the EBnet, ASTER GDS and the interrelationship.

Section 4 presents an interface detailed design.

Section 5 describes the facilities and maintenance demarcation.

A list of abbreviations and acronyms is provided at the end of the document.

Section 2. Related Documentation

2.1 Parent Documents

[1] *Earth Observing System AM-1 Detailed Mission Requirements*, Goddard Space Flight Center (GSFC), 505-10-33, November 1996

[2] *Earth Science Data Information System (ESDIS) Project Level 2 Requirements Volume 6, EOSDIS Backbone Network (EBnet) Requirements*, Goddard Space Flight Center (GSFC) 505-10-01-6, Revision A, December 1996

[3] *Earth Observing System (EOS) Data and Information System (EOSDIS) Backbone Network (EBnet) Interface Requirements Document (IRD)*, September 1997

[4] Reserved

2.2 Applicable Documents

[5] *Electrical Characteristics of Balanced Voltage Digital Interface Circuits*, Electronic Industries Association (EIA) 422-A, December 1978

[6] *General-Purpose 37-Position and 9-Position Interface for Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Data Interchange*, EIA 449, November 1977

[7] *Implementing Arrangement between the National Aeronautics and Space Administration of the United States of America and the Ministry of International Trade and Industry of Japan concerning Cooperation on the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Program, November 7, 1996*

[8] *Internet Protocol (IP): DARPA Internet Program Protocol Specification*, Request for Comment (RFC) 791, September 1981

[9] *The Point-to-Point Protocol (PPP)*, RFC 1661, July 1995

[10] *An Ethernet Address Resolution Protocol or Converting Network Protocol Addresses to 48-bit Ethernet Addresses for Transmission on Ethernet Hardware*, RFC 826, November 1982

[11] *Internet Control Message Protocol*, RFC 792, September 1981

[12] *Routing Information Protocol (RIP)*, RFC 1058

[13] *Open Shortest Path First (OSPF)*, RFC 1247

[14] *Internet Group Multicast Protocol (IGMP)*, RFC 1112

[15] *On the Assignment of Subnet Numbers*, RFC 1219

[16] *Simple Network Management Protocol (SNMP)*, RFC 1157

[17] *Address Resolution Protocol (ARP)*, RFC 826

[18] *A Reverse Address Resolution Protocol (RARP)*, RFC 903

[19] *Internet Protocol on Ethernet Networks*, RFC 894

[20] *Project Implementation Plan Volume II, Ground Data System, Advanced Spaceborne Thermal Emission and Reflection Radiometer, and ESDIS and EOS-AM Projects*, 505-10-111, July 1996

[21] *Transmission of IP over FDDI*, RFC 1188

[22] *Structure of Management Information*, RFC 1155

[23] *Management Information Base - II*, RFC 1213

[24] *Transmission Control Protocol*, RFC 793

[25] *Telnet Protocol*, RFCs 854 & 855

[26] *File Transfer Protocol*, RFC 959

[27] International Organization for Standardization (ISO) 9314-1, *FDDI Physical Layer Protocol (PHY)*

[28] ISO 9314-2, *FDDI Media Access Control (MAC) Protocol*

[29] ISO 9314-3, *FDDI Physical Layer Medium Dependent (PMD)*

[30] ISO 8802-2, *Logical Link Control (LLC)*

[31] ISO 8802-3, *Carrier-Sense Multiple-Access with Collision Detection (CSMA/CD) Media Access Control (MAC) - Ethernet version 2*

[32] Institute of Electrical and Electronic Engineers (IEEE) 802.3 *10Base-T (twisted pair)*

[33] IEEE *10Base5 (thick ethernet)*

[34] International Telegraph and Telephone Consultative Committee (CCITT) *V.35*

2.3 Reference Documents

[35] *Earth Science Data Information System (ESDIS) Data and System Operation Requirements Volume 2*, Revision A March, 1997

[36] *NASA Communications (Nascom) Access Protection Policy and Guidelines*, 541-107, Revision 3, GSFC, November 1995

[37] *NASA Communications System Acquisition and Management*, NASA Management Instruction (NMI) 2520.1D, NASA, November 18, 1991

[38] *Nascom IONET Users Guide*, 541-225, Revision 1, April 1996

Section 3. Systems Overview

3.1 EBnet General System Description

The EBnet provides wide-area communications circuits and facilities between and among various EOS Ground System (EGS) elements to support mission operations and to transport mission data between EOSDIS elements. The relationship of EBnet to other elements supporting EOS is shown in Figure 3-1. EBnet is responsible for transporting spacecraft command, control, and science data nationwide on a continuous basis, 24 hours a day, 7 days a week. The EBnet capability to transport these diverse types of data is implemented as two distinct subnetworks referred to as "real-time" and "science" networks. The real-time network transports mission-critical data related to the health and safety of on-orbit space systems and raw science telemetry as well as pre-launch testing and launch support. This highly redundant network provides an operational availability of 0.9998 with a Mean Time to Restore Service (MTTRS) of 1 minute. The science network transports data collected from spacecraft instruments and various levels of processed science data including expedited data sets, production data sets, and rate-buffered science data. The science network provides an operational availability of 0.98 with a MTTRS of 4 hours.

EBnet provides three options for accessing the Internet Protocol (IP)-based EBnet transport service: Local Area Network (LAN) Ethernet, LAN Fiber Distributed Data Interface (FDDI), and Wide Area Network (WAN) carrier service. Figure 3-2 shows an example of these types of interface/demarcation points to EBnet users. This ICD describes the EBnet/ASTER GDS interface which uses the WAN interface type.

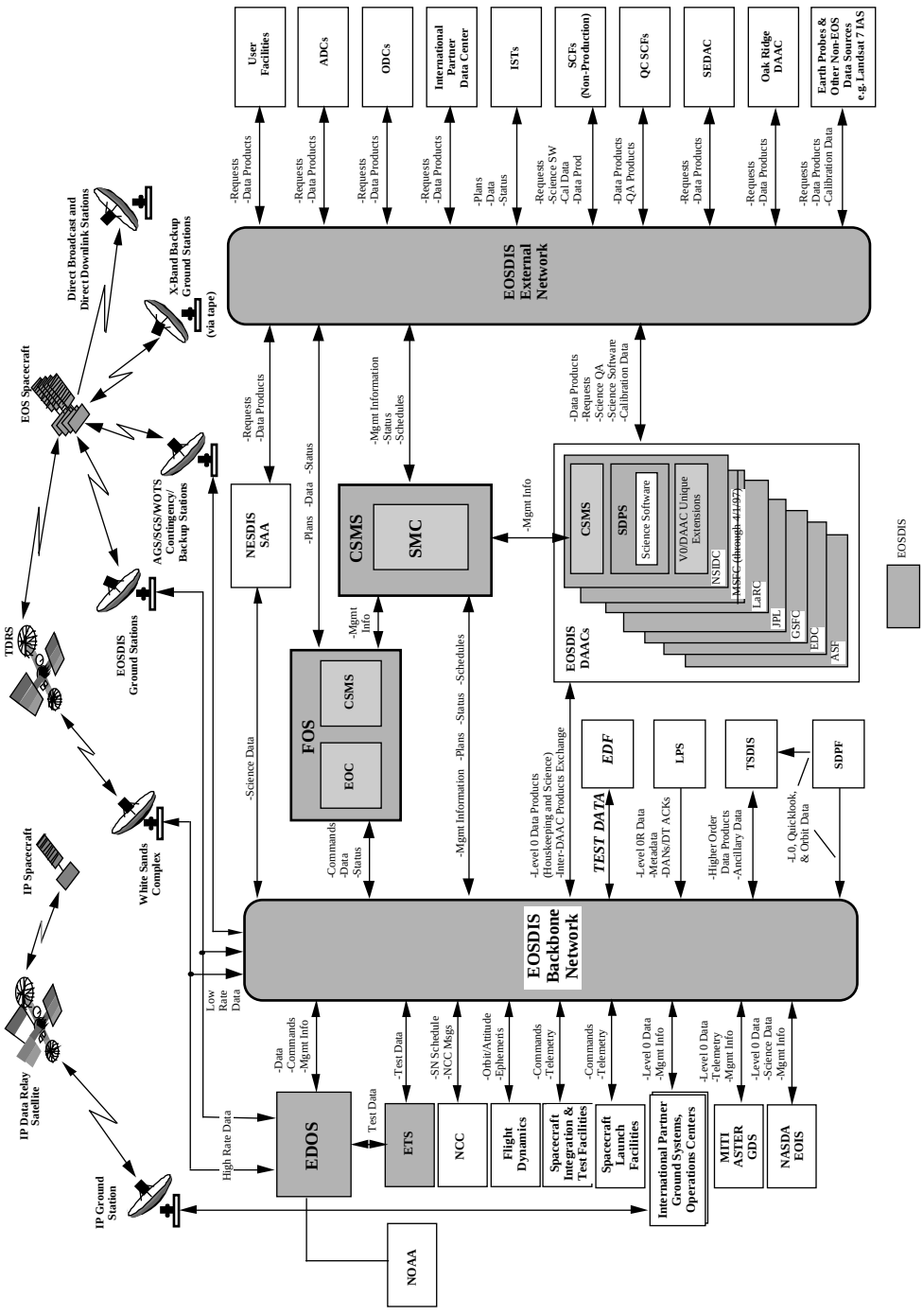

Figure 3-1. EOS Ground System

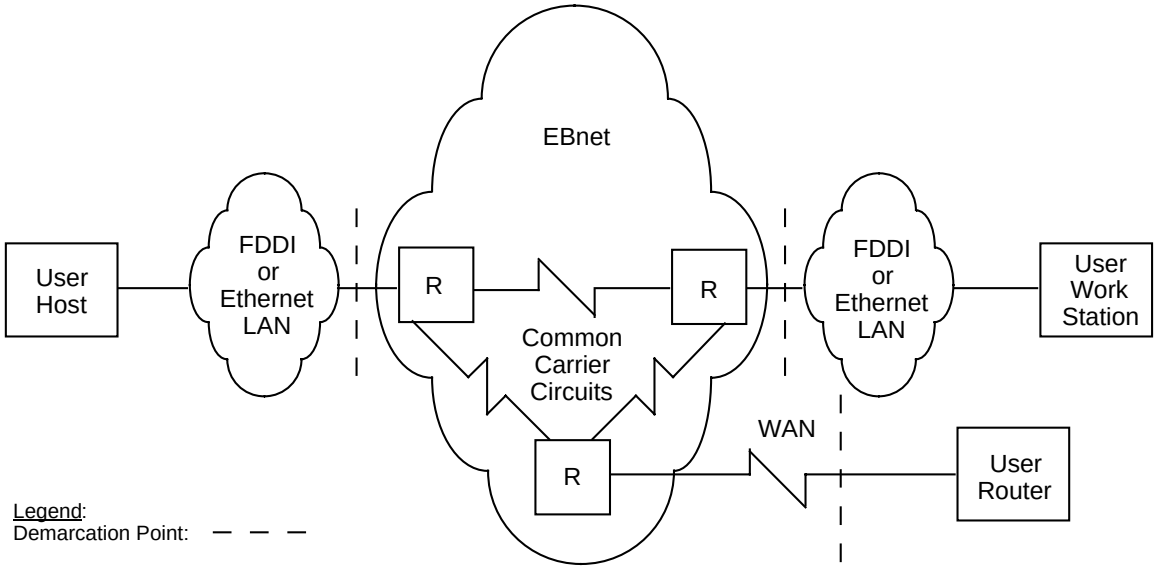

Figure 3-2. EBnet Demarcations

Sustaining engineering, preventive and remedial maintenance, and network monitoring services are provided for EBnet equipment, to ensure that EBnet keeps pace with technology and standards, and provides continuous service. The official point of contact for EBnet operational status is the Nascom Communications Manager (301-286-6141). Users who detect a network problem are urged to immediately report it to the Communication Manager (COMMGR.) The COMMGR may also provide users with limited information about maintenance and status actions. Refer to the Nascom IP Operational Network (IONET) User Guide (541-225) for information regarding user connections, security guidelines, and maintenance information.

3.2 ASTER GDS Description

3.2.1 ASTER GDS Overview

The ASTER GDS has been defined as a hierarchy of segments, subsystems, and components. Three ASTER GDS segments are defined to support three major operational areas: the ASTER Operation Segment (AOS), the Communications and System Management Segment (CSMS), and the Science Data Processing Segment (SDPS). The segments are further divided into ASTER GDS functional elements to provide the support required by the operational segments. The major elements of the ASTER GDS are described briefly below.

3.2.1.1 ASTER Operations Segment

The AOS manages the ASTER instrument operations and controls the ASTER instrument through the EOS Operations Center (EOC). The AOS elements are the Instrument

Control Center (ICC), including the Instrument Control Operation Subsystem, the Instrument Analysis Support Subsystem, and the Instrument Support Terminal (IST). The ICC is responsible for the operations of the ASTER instrument. It performs planning, scheduling, commanding (via EOSDIS), and monitoring. The IST is defined as a facility that connects the ASTER Science Team Leader to the ICC in support of instrument operation.

3.2.1.2 ASTER Communications and System Management Segment

The ASTER CSMS provides system resource management, communications services, and a data information system for the entire ASTER project. The CSMS includes the Ground System Management Subsystem (GSMS), and the ASTER Data Network (ADN). The GSMS provides system management services for the ASTER GDS elements, plus coordination of ground system operations within and between these elements. The ADN provides an internal network for communications among the ASTER GDS elements, a network interface to the science user network, network services at the application layer and a network management facility.

3.2.1.3 ASTER Science Data Processing Segment

The ASTER SDPS provides a set of processing and distribution elements for ASTER science data, a direct receiving element for ASTER raw data, and a software implementation system for the entire ASTER Product Generation Subsystem (PGS). The ASTER SDPS elements include the PGS, consisting of the Data Processing Subsystem (DPS), the Data Analysis Subsystem (DAS) and other subsystems, the Information Management Subsystem (IMS), the Direct Downlink (DDL) Receiving Station (DRS), the ASTER Data Archive and Distribution Subsystem (DADS), and the Software Implementation Support Subsystem (SISS). The PGS and DADS facilities process the data from Level 0 data up to standard higher data products, provide short- and long-term storage for the ASTER project, and distribute the data to users. The IMS provides a data and information management service including a catalog system in support of user data selection and ordering.

3.2.2 ASTER Instrument Description

The ASTER instrument will provide high-resolution images of the land surface and clouds for climatological, hydrological, biological, and geological studies. The ASTER instrument has three major, independently commandable subsystems: visible and near infrared (VNIR), short-wave infrared (SWIR), and thermal infrared (TIR). VNIR, SWIR and TIR will have the capability to image the same 60 kilometer (km) imaging swath with pointing capability in the cross-track direction within the range of 272 km. The three radiometers are used together to acquire dayside images for pre-planned targets during the observation period for up to 16 minutes. TIR and SWIR are used for imaging nightside targets for up to 2 minutes of observation each.

VNIR provides images in three visible and near-infrared bands—centered at 0.56, 0.66, and 0.81 micrometers (μm)—with a spatial resolution of 15 meters (m). VNIR has two

telescopes: a nadir-looking telescope operating in all three bands, and a backward-looking telescope operating in the 0.81 μm band only. VNIR can be pointed across track at any angle up to 24 degrees.

SWIR provides images in six short-wave infrared bands between 1.65 and 2.40 μm with a spatial resolution of 30 m. SWIR can be pointed across the track at any angle up to 8.55 degrees in either direction.

TIR provides images in five thermal infrared bands between 8.30 and 11.30 μm with a spatial resolution of 90 m. TIR can be pointed across the track at any angle up to 8.55 degrees in either direction by rotating its scan mirror.

3.3 Relationship Between EBnet and ASTER GDS

The purpose of the interface between the ASTER GDS and EBnet is to support connectivity between the ASTER GDS and the following systems:

a. EOS Data and Operational System (EDOS) at GSFC.

b. EOC at GSFC.

c. Systems Monitoring and Coordination Center (SMC) at GSFC.

d. Distributed Active Archive Center (DAAC) at GSFC.

e. ASTER IST-US at Jet Propulsion Laboratory (JPL).

f. IMS-US.

The general overview block diagram of the EOSDIS traffic flow through EBnet to ASTER GDS is illustrated in Figure 3-3. The ASTER GDS flows received from EDOS consist of both real time and science traffic types (for purposes of EBnet ICDs, any traffic type which is not real time is considered to be science traffic.) The ASTER GDS flows with the EOC consist of both real time and science traffic. The ASTER GDS flows with the SMC are considered to be science traffic. The ASTER GDS flows with the DAAC are considered to be science traffic.

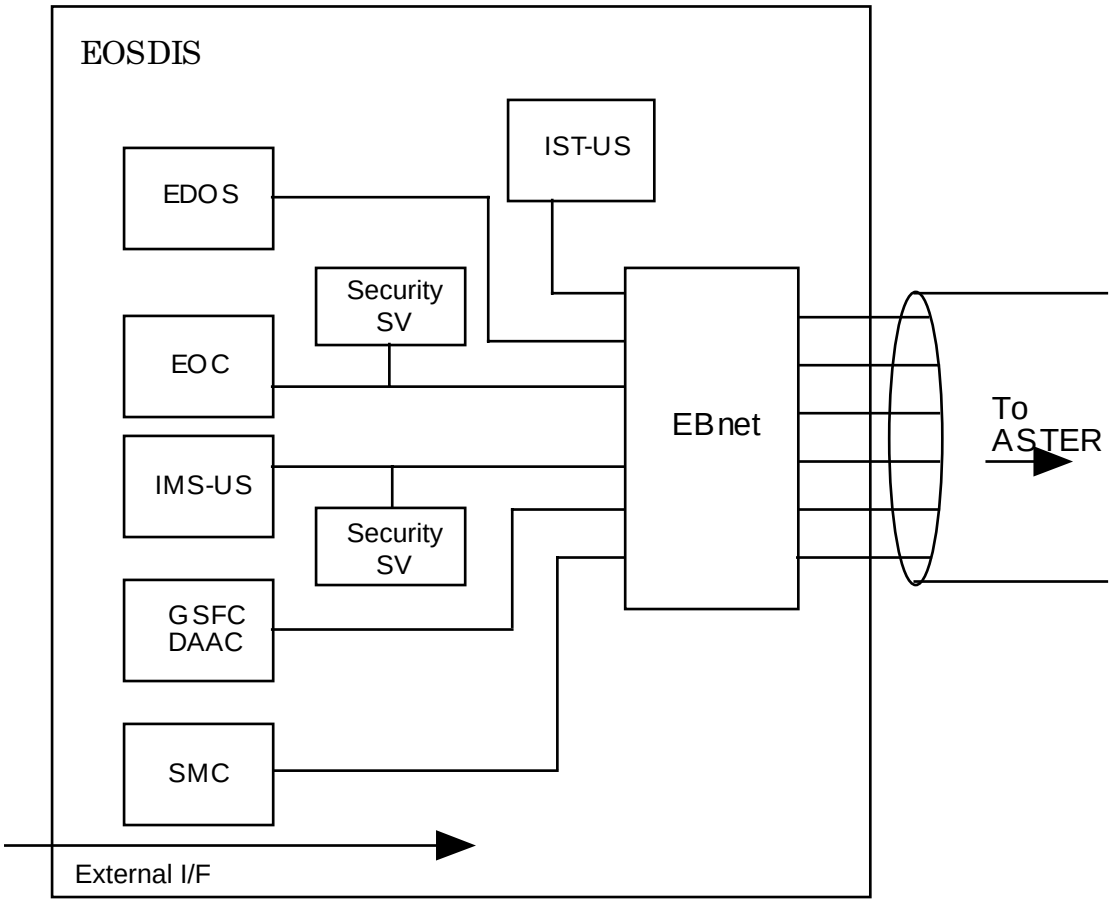

Figure 3-3. EBnet Network Architecture for ASTER Traffic

Section 4. Interface Detailed Design

4.1 Interface Design Overview

The GSFC EBnet and ASTER GDS interface design, as shown in Figure 4-1, consists of two routers for data transport over a trans-Pacific common carrier circuit. Along with this primary data capability, a dial-up backup capability for data is provided for use only in the event of a failure of the primary service. The physical demarcation point between EBnet and ASTER GDS is at the output of the router shown by the dotted line in Figure 4-1. A router will provide the data capabilities and the dial-up backup capability in the event of a failure in the primary communication path using a Basic Rate Interface (BRI) Integrated Services Digital Network (ISDN) service connection. Two routers are connected in a redundant configuration at the GSFC EBnet and ASTER GDS EBnet sites in order to provide adequate system availability in the event of a single equipment failure. This arrangement of equipment and dial backup service provides the necessary system availability.

4.2 Design Assumptions

a. WAN circuit bandwidth is 512 kilobits per second (kbps.)

b. Data backup capability will use ISDN service.

4.3 Data Interface Design

The Data Interface Design provides a primary communication service along with a BRI ISDN service connection for as needed dial back-up capability. Separate routers, as shown in Figure 4-1 will be used to implement the primary and back-up capabilities.

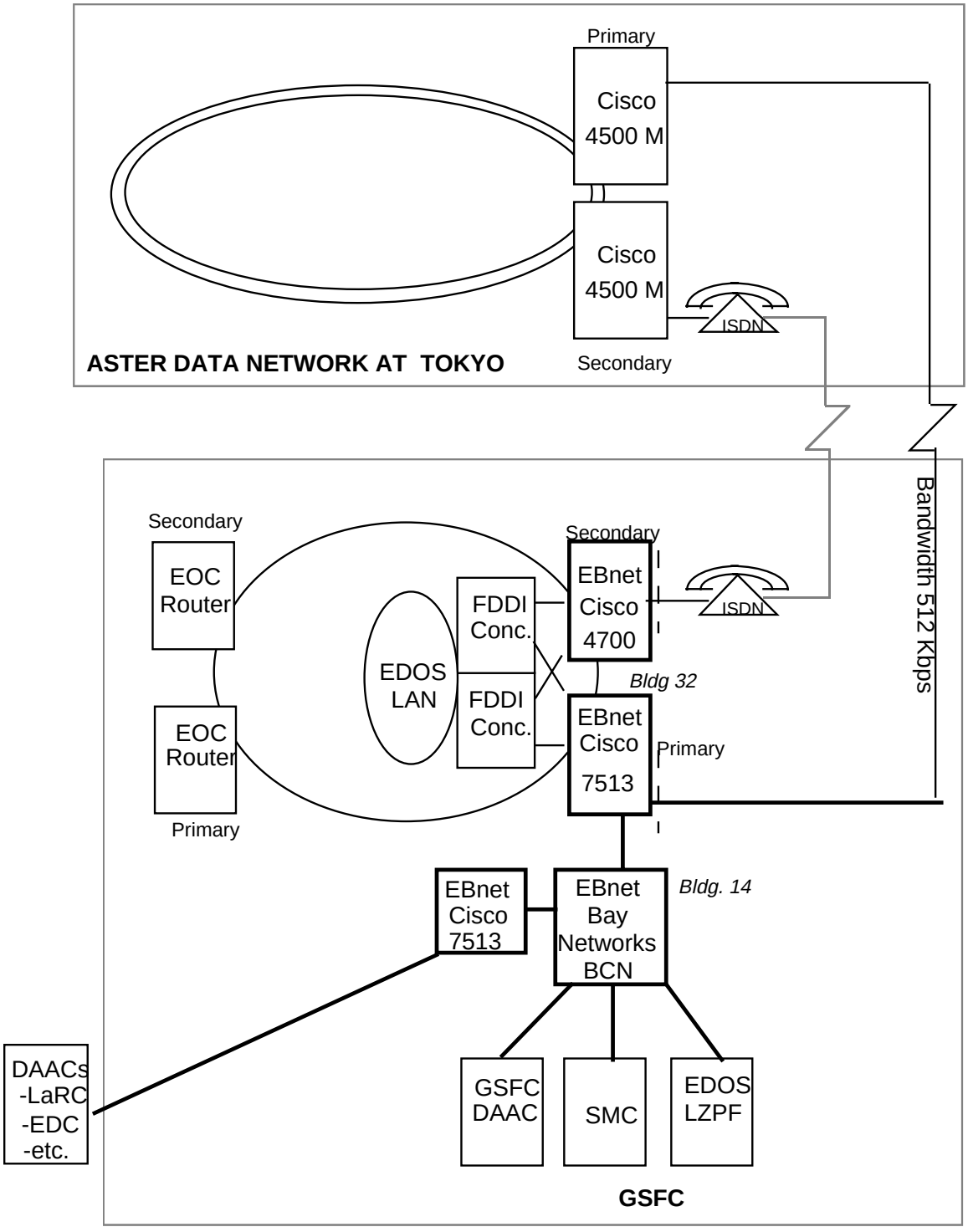

Figure 4-1. ASTER-GDS Interface

4.3.1 Primary Communication, Router Interface

A router will provide the data communication interface for the primary service. Figure 4-2 shows the network, data link, and physical layers used by the router. The protocols for each layer are described in the following paragraphs.

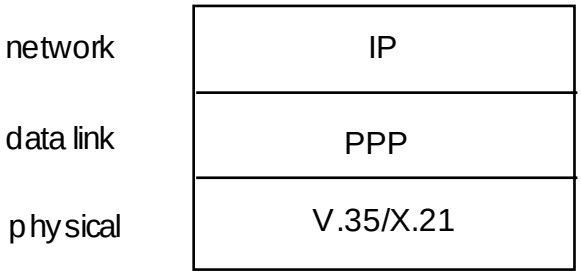

Figure 4-2. Data Protocol Stack

4.3.1.1 Network Layer Protocol

The network layer shall support, at a minimum, the following protocols:

a. IP version 4 [8].

b. Internet Control Message Protocol (ICMP) [11].

c. Address Resolution Protocol (ARP) [17].

d. Protocol Independent Multicast (PIM).

e. Routing Protocol: Static.

4.3.1.2 Datalink Layer Protocols

The datalink layer shall support, at a minimum, the following protocols:

a. Point-to-Point Protocol (PPP) [9].

4.3.1.3 Physical Layer Protocols

The physical layer interface between the routers is V.35 or X.21.

4.3.2 Dial Back-up Communication, Router Interface

A secondary router will provide the dial backup capability in the event of a failure in the primary communication path using a BRI ISDN service connection. The specific details of the protocols used in this interface is dependent on the ISDN service provider.

4.3.2.1 Network Layer Protocol

The network layer shall support, at a minimum, the following protocols:

a. IP version 4 [8].

b. ICMP [11].

c. ARP [17].

d. PIM.

e. Routing Protocol: Static.

4.3.2.2 Datalink Layer Protocols

{The specific details of the protocols used in this interface are dependent on the ISDN service provider.}

4.3.2.3 Physical Layer Protocols

{The specific details of the protocols used in this interface are dependent on the ISDN service provider.}

4.4 Performance

The EBnet/ASTER GDS interface shall meet the following performance specifications:

a. Data rate 512 kbps.

4.5 Equipment List

EBnet will provide the following equipment to support this interface:

Primary GSFC EBnet Router: Cisco (Model 7513).

Secondary GSFC EBnet Router: Cisco (Model 47~~74~~00).

Primary ASTER GDS EBnet Router: Cisco (Model 4500M).

Secondary ASTER GDS EBnet Router: Cisco (Model 4500M).

Section 5. Facilities and Maintenance Demarcation

5.1 ASTER GDS Location

The ASTER GDS physical location will be at Fore Front Tower Building, 14th floor Kachidoki, Chuoku, Tokyo, Japan.

5.2 GSFC EBnet Location

Both, primary and secondary EBnet routers will be located in the Building 32, Room C210H.

Abbreviations and Acronyms

ADN	ASTER Data Network
AOS	ASTER Operation Segment
ARP	Address Resolution Protocol
ASTER	Advanced Spaceborne Thermal Emission and Reflection Radiometer
BRI	Basic Rate Interface
CCB	Configuration Control Board
CCITT	International Telegraph and Telephone Consultative Committee
COMMGR	Communication Manager
CSMA/CD	Carrier-Sense Multiple-Access with Collision Detection
CSMS	Communication and System Management Segment
DAAC	Distributed Active Archive Center
DADS	Data Archive and Distribution Subsystem
DAS	Data Analysis Subsystem
DCN	document change notice
DDL	Direct Downlink
DPS	Data Processing Subsystem
DRS	DDL Receiving Station
EBnet	EOSDIS Backbone Network
EDOS	EOS Data and Operations System
EGS	EOS Ground System
EIA	Electronic Industries Association
EOC	EOSDIS Operations Center
EOS	Earth Observing System
EOSDIS	Earth Observing System Data and Information System
ESDIS	Earth Science Data Information System
FDDI	Fiber Distributed Data Interface

GDS	Ground Data System
GSFC	Goddard Space Flight Center
GSMS	Ground System Management Subsystem
ICC	Instrument Control Center
ICD	Interface Control Document
ICMP	Internet Control Message Protocol
IEEE	Institute of Electrical and Electronic Engineers
IGMP	Internet Group Multicast Protocol
IMS	Information Management Subsystem
IONET	IP Operational Network
IP	Internet Protocol
IRD	Interface Requirements Document
ISDN	Integrated Services Digital Network
ISO	International Organization for Standardization
IST	Instrument Support Terminal
JPL	Jet Propulsion Laboratory
Kbps	Kilobits per second
km	kilometers
LAN	local area network
LLC	Logical Link Control
m	meters
MAC	Media Access Control
µm	micrometers
MO&DSD	Mission Operations and Data Systems Directorate
MTTRS	Mean Time to Restore Service
NASA	National Aeronautics and Space Administration
Nascom	NASA Communications
NMI	NASA Management Instruction
OSPF	Open Shortest Path First

PGS	Product Generation Subsystem
PHY	Physical Layer Protocol
PIM	Protocol Independent Multicast
PMD	Physical Layer Medium Dependent
PPP	Point-to-Point Protocol
RARP	Reverse Address Resolution Protocol
RFC	Request for Comment
RIP	Routing Information Protocol
SDPS	Science Data Processing Segment
SISS	Software Implementation Support Subsystem
SMC	Systems Monitoring and Coordination Center
SNMP	Simple Network Management Protocol
SWIR	short-wave infrared
TIR	thermal infrared
US	United States
VNIR	visible and near infrared
WAN	wide area network